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METHOD FOR MANUFACTURING PACKAGING MATERIALS WITH A POLYOLEFIN FOAM LAYER

The invention is in the field of the packaging industry and relates to a method according to the generic part of the independent claim and to packaging materials produced according to the inventive method. The method serves for manufacturing packaging materials consisting of a polyolefin foam layer which is coated with a coating film on at least one side.

Packaging materials with a foam layer of e.g. polypropylene, in the form of quasi endless, rolled webs are used for producing thermoformed, self supporting packaging items as e.g. trays for food, which trays are, after filling e.g. closed with a transparent film. Such materials are applicable in the so called "Form-Fill-Seal" packaging method (FFS-method). For this method the packaging material is fed into an apparatus in which it is formed into a web of trays, which trays in the same apparatus are filled, sealed with a sealing film

In these packaging materials the polypropylene foam layer is coated either on

layer in order to make it tight and to prevent liquid to enter into the inside of the foam material. Depending on the composition and thickness of the coating film, this film may also serve as a further means for increasing the stiffness, as protection of the foam surface and/or as gas and aroma barrier. Usually the coating film carries on its surface facing away from the foam layer a sealing layer which serves as a bonding layer between the packaging material and a transparent film used for closing the packaging item (tray).

Packaging materials with a polypropylene foam layer for producing trays by thermoforming are described e.g. in the publication EP-A1-0570222. The described materials are manufactured by thermobonding (lamination by application of heat and pressure) to a sheet of a polypropylene foam, a multi-layer film, which multilayer film includes a barrier layer rendering the packaging material gas- and/or aroma-tight. This multilayer film needs a bonding layer facing the foam sheet which bonding layer has to consist of a material capable of adhesion to the foam sheet in the thermobonding process, i.e. when exposed to heat and pressure. The heat which may be used for the bonding is limited by the polypropylene foam which is to be laminated without change to its structure by the heat applied. This means that the bonding layer of the coating film needs to be made of a polymer plasticating at a considerably lower temperature than polypropylene, e.g. an ethylene copolymer.

The low melting bonding layer renders the whole structure rather thermo-sensitive and represents a foreign material [illegible]

[illegible] foam layer rather narrow because there has to exist a material for the bonding layer plasticating at a lower temperature than the foam material and still satisfying the minimal demands on thermal stability which [illegible] packaging item made [illegible]

on the material of the bonding layer render the coating film structure complicated as can be seen from the example given in the above mentioned publication.

In the publication EP-344726 similar packaging materials are described, which packaging materials consist substantially of a foamed plastic (e.g. polypropylene) coated on one or both sides. For producing the material adhesion methods (as EP-0570222) are proposed or coextrusion methods. For the coextrusion method, the foamed layer is coextruded with additional layers either of the same plastic material as the foamed material or of a different plastiac material.

It is the object of the invention to create a method for manufacturing packaging materials with a polyolefin foam layer applicable for forming self supporting packaging items such as trays for food packaging, which method allows to omit a bonding layer with a substantially lower thermostability than the foam layer has. Using the inventive method allows therefore a larger choice of polyolefins for the foam layer than do known such methods. The packaging material produced by the method is to contain less material different from the foam material than known such packaging materials do. The method is not to be connected with more expenditure than known methods for manufacturing packaging materials with a polyolefin foam layer usable for the same purposes.

The above objects are achieved by the method for producing packaging materials with a polyolefin foam layer as defined by the patent claims.

~~the foam layer is coextruded with the layer or layers of the coating film. To achieve good bonding between the foam layer and the layer next to the foam layer it is necessary that the layer consists of a polyolefin whose monomer which is the main monomer of the polyolefin of the foam layer (e.g. propylene),~~

~~This means that in the coextruded packaging material on the surface of the foam layer there is positioned a layer made from basically the same polyolefin as the polyolefin of the foam layer. This bonding layer may be the only layer of a single-layer coating film or the innermost layer of a multilayer coating film.~~

Thereby
~~If extrusion lamination is used~~, a foam sheet produced in a separate method step by extrusion and expansion is coated by extrusion lamination with a single-layer or a multilayer coating film produced in a separate method step by coextrusion. This means that the polyolefin foam sheet and the coating film are guided together and a further bonding layer is extruded between them. This further bonding layer extruded in the extrusion lamination step consists of a polyolefin based on the main monomer if the foam layer. Immediately after the extrusion of the further bonding layer, there is sufficient pressure applied to the composition to achieve a satisfactory bond without impairing the foam layer. ~~For the extrusion lamination method also,~~ The coating film needs a bonding layer facing towards the foam layer (or rather toward the further bonding layer) which consists of a polyolefin based on the monomer which is the main monomer of the polyolefin of the foam layer (e.g. propylene) also. This bonding layer again may be the only layer of a single layer coating film or it may be the innermost layer of a multilayer coating film.

according to the inventive method
The packaging material produced ~~with the extrusion lamination step~~ always shows on the surface of the foam layer two layers of basically the same poly...

If the foam layer is to be coated on both sides, this can be done by produc...

coating the foam layer in two extrusion lamination steps. ~~It can also be done by coextrusion of all the layers in one single coextrusion step~~. It can further be done by producing a foam layer coated on one side by coextrusion and coat this layer on the other side by extrusion lamination with a coating film produced in a separate coextrusion or extrusion step. In all cases, on the coated surface of the polyolefin foam layer there ~~is at least one~~ are two layers of basically the same polyolefin as the polyolefin of the foam layer.

The inventive method and packaging materials produced with the inventive method are described in more detail in connection with the following Figures. Wherein:

Figure 1 shows schematically an exemplified embodiment of the inventive method for producing by extrusion lamination a packaging material coated on one side with a multilayer coating film;

~~**Figure 2** shows schematically an exemplified embodiment of the inventive method for producing by coextrusion a packaging material coated on one side with a multilayer coating film;~~

Figure 2 shows schematically an exemplified embodiment of the inventive method for producing by coextrusion and extrusion lamination a packaging material coated on one side with a multilayer and on the other side with a single-layer coating film;

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materials with a polypropylene foam layer. This does not limit the inventive

method to the production of polypropylene based packaging materials. The same method may be applied for producing polyethylene based materials or materials based on other polyolefins.

Figure 1 shows schematically an exemplified embodiment of the inventive method with three method steps 1, 2 and 3. Method step 1 is a coextrusion or extrusion step in which the multilayer (e.g. five-layer) or single layer coating film A is produced. Method step 2 is an expansion and extrusion step in which the polyolefin sheet B is produced. Method step 3 is an extrusion lamination step in which the final packaging material C is produced by extruding a polyolefin bonding layer 30 between the foam sheet B and the coating film A and applying enough pressure to the product (e.g. by pressing rolls 31) to achieve a satisfactory bond.

The foam sheet B produced in method step 2 consists of a foamed polyolefin. For forming selfsupporting packaging items such as trays, applicable in food packaging, foamed polypropylene is used advantageously, as it is self-supporting with feeble thickness and feeble density. A mixture of polypropylene with long chain branching (high melt strength polypropylene) and a propylene-ethylene-copolymer (e.g. heterophasic block propylene-ethylene-copolymer) expanded with the help of a solid or a gaseous blowing agent result in a packaging material which is thermoformable but, thanks to its reduced brittleness, is formable into packaging items such as trays by folding also. Very good results are achieved with a mixture with equal parts of the

Polypropylene foam sheets for the application in packaging materials for
mm and a density of

count of 100 to 300 cells per mm^3. Density and cell count can be influenced by changing the extrusion pressure and other process conditions.

The polyolefin extruded in method step 3 is to be based on the same monomer as the main monomer of the foam layer. In case of the above described foam being made of a mixture of polypropylene and a polypropylene copolymer it is preferably polypropylene. The extruded bonding layer advantageously has a thickness of 5 to 30 µm.

The coating film A produced in the method step 1 is to have at least one surface (e.g one surface layer 14) consisting of a polyolefin based on a monomer which is the same as the main monomer of the foam layer, preferably the same polyolefin as the one extruded in method step 3. This one surface of the coating film is to face the foam sheet in method step 3. Examples of different coating films are described in connection with Figures 4 3 to 6.5.

The third method step may be repeated for coating the other surface of the foam layer also, whereby the coating films on the two sides of the foam layer may be similar or different from each other.

It is possible to carry out the second and the third method step within the

[illegible]

the layers of a multilayer coating film A or the one layer of a single layer coating film are coextruded. For achieving a good bond the one surface of the coating film A which is facing the foam layer consists of a polyolefin based on the monomer which is the main monomer of the polyolefin of the foam layer. This surface of the coating film is, as shown in Figure 2, a bonding layer 14 of a multilayer coating film and then may have a thickness down to 5 µm. It may also be one surface of a single layer coating film, which single layer at the same time is a bonding layer and a protecting layer and in this case preferably has a more important thickness.

It is obvious that by adding more extrusion dies to the coextrusion apparatus for carrying out the method according to Figure 2, it is possible to coat a foam layer on both sides in one single coextrusion step.

Figure 2 shows a further exemplified embodiment of the inventive method, containing a coextrusion step 4 for coating the one side of a foam layer B with a single-layer coating film A' and an extrusion lamination step 3 for coating the other side of the foam layer B with a multilayer coating film A. ~~The method according to Figure 3 is a combination of the methods according to Figures 1 and 2 and therefore does not need any further description. In all three Figures similar items are designated with the same reference numerals.~~

Figures 3 to 5 show in cross section exemplified coatings of foam layers producable with the inventive method. All the shown coatings are produced with

layer being part [illegible]

the extrusion lamination step. ~~All the shown coatings may be produced with a coextrusion step also. They would then look the same except that the further~~

~~coating layer [illegible]~~

Figure 3 shows a cross section through an exemplified packaging material produced by the inventive method. The packaging material consists of the three basic components: the coating film A, the foam layer B and the further bonding layer 30 extruded in method step 3 (Figure 1) between foam layer B and coating film A.

The five-layer coating film shown in Figure 3 consists of a barrier layer 11 made e.g. of ethylene-vinyl-alcohol-copolymer, adhesive layers 12 and 13 on either side of the barrier layer 11, a bonding layer 14 facing the extruded further bonding layer 30 and a sealing layer 15 e.g. consisting of low density polyethylene or peelable polyethylene which is bondable to film material with which the packaging item, e.g. tray, is to be covered for closing. The sealing layer 15 may be replaced by a protection layer without sealing function, e.g. made of polypropylene like the bonding layer 14. Packaging material with such a protecting layer may be used for packaging items which do not require heat sealing for closing.

The adhesive layers 12 and 13 consist of an adhesive suitable for bonding ethylene-vinyl-alcohol-copolymer. For the illustrated case the first adhesive layer 12 bonding the barrier layer 11 to the bonding surface layer 14 (polypropylene) consists of a propylene-copolymer, the second adhesive layer 13 bonding the barrier layer 11 to the sealing layer 15 (polyethylene) consists of an ethylene-copolymer.

Advantageous thicknesses of the different layers in the packaging material shown in Figure 3 are: sealing layer 15: 10 - 50 µm, adhesive layers 12 and 13: 3 - 5 µm, barrier layer 11 [illegible]

Figure 4 shows a cross section through a further exemplified coating of a packaging material produced with the inventive method. The basic components are as in Figure 3: polypropylene foam layer B, polypropylene extruded further bonding layer 30 and coating film A. The coating film contains three layers: polypropylene bonding layer 14, sealing layer 15 and, if necessary an adhesive layer 16 inbetween.

Figure 5 shows a cross section of a further exemplified coating of a packaging material produced with the inventive method. The coating film A of this material is an extruded single-layer film consisting of polypropylene, serving both as bonding layer 14 and as protecting layer.

Figures 3 to 5 all show only one coated surface of a foam layer. The other surface of the foam layer is either uncoated or coated, wherein all combinations of the three shown or of other similar coatings are thinkable.